

The Climate of the 20th Century Plus Detection and Attribution Project: Experimental design

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Current climate model products are not designed for investigating extreme weather under a changing climate

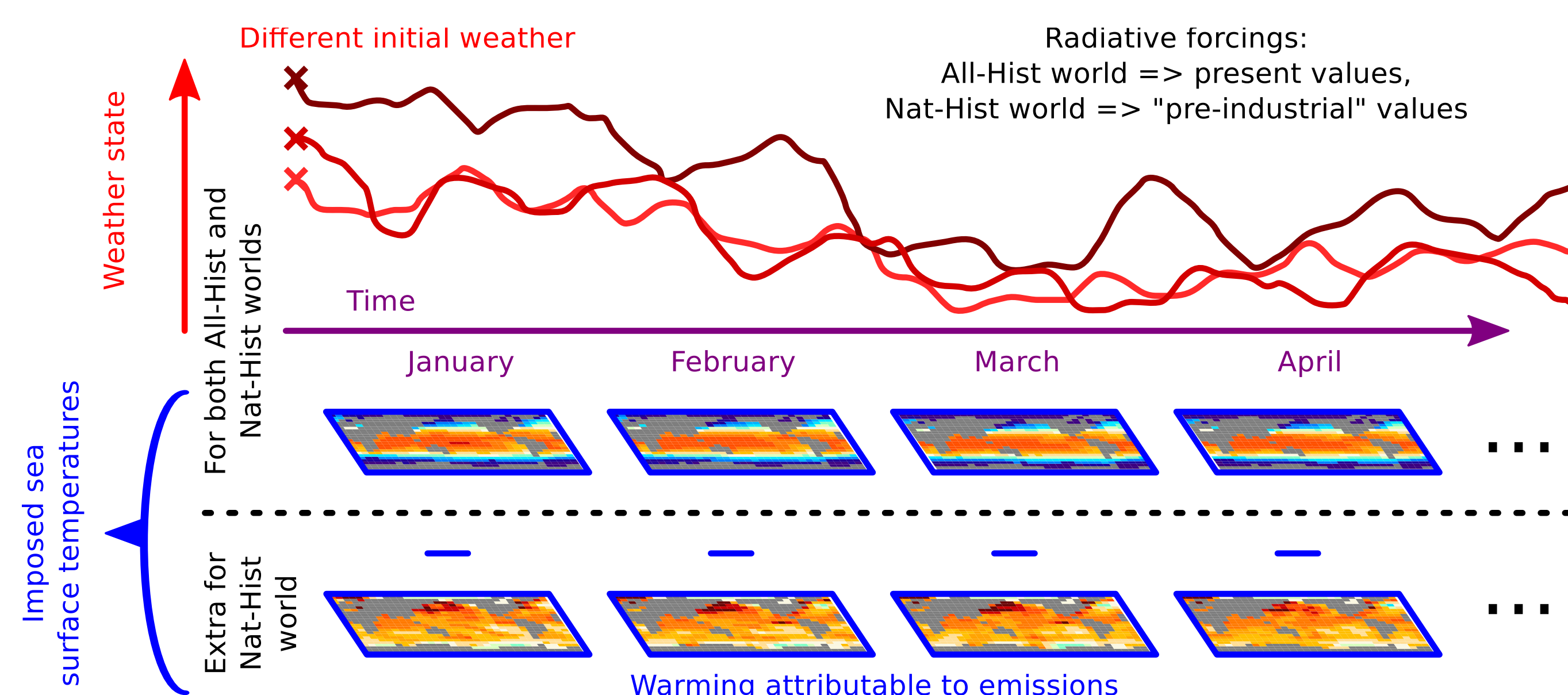
The emerging field of event attribution aims to estimate the degree to which anthropogenic emissions has contributed to recently experienced extreme climate events.

NEED FOR PRODUCT THAT:	C20C+ D&A:
Allows characterization due to model design	Uses multiple climate models
Allows characterization of uncertainty due to experiment design	Includes data for trend analysis and factual-counterfactual analysis, with multiple planned counterfactual estimates
Provides good sampling of rare extremes	Includes large initial-condition ensembles
Provides reliable representation of extremes	Uses observed ocean temperatures, atmospheric models at higher average spatial resolution than e.g. CMIP5
Facilitates rapid analysis of extremes	Publishes simulation output on a public portal

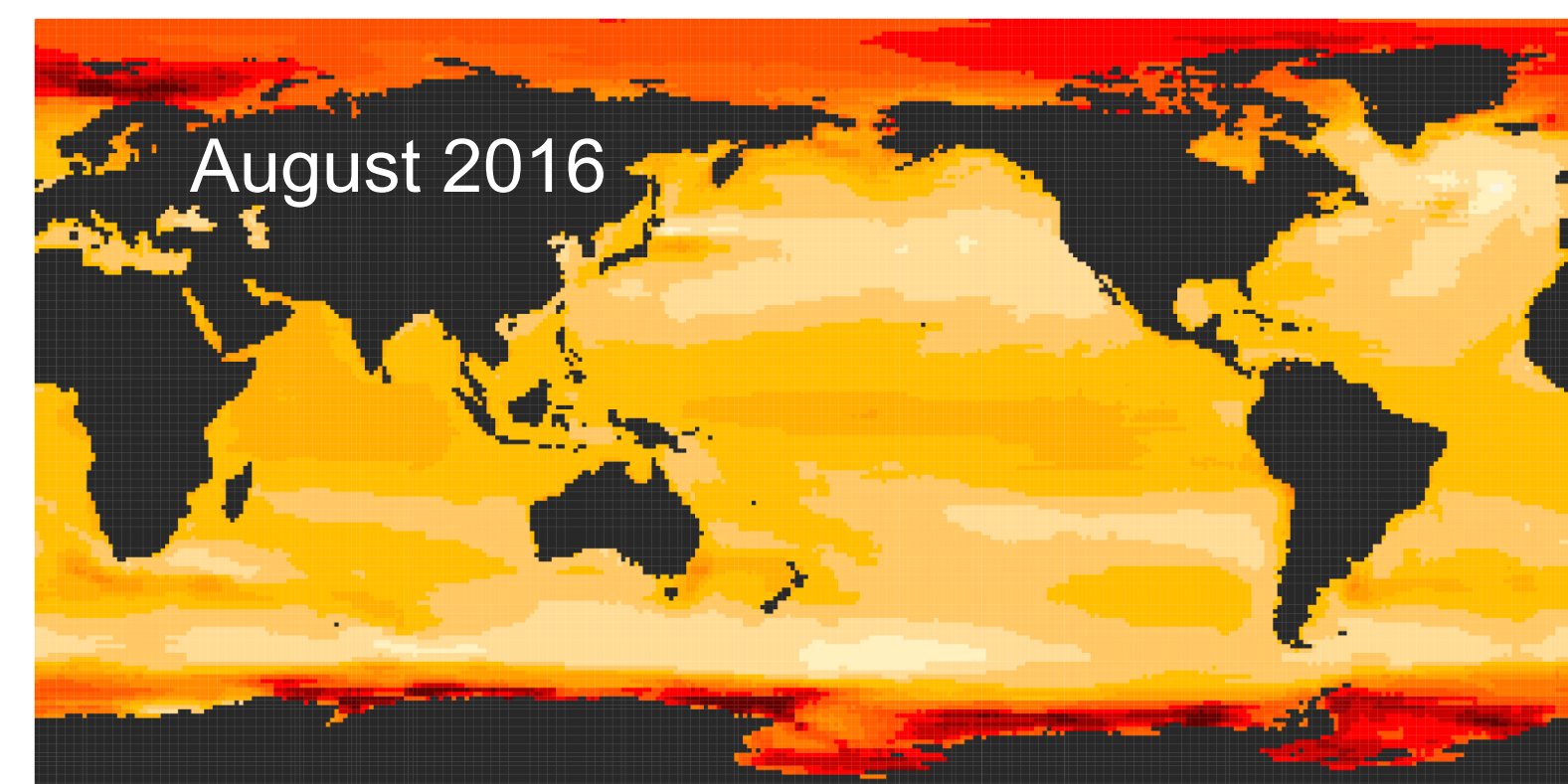
Experimental design

Run a large number of simulations of atmospheric models:

- Of the factual “real world” (All-Hist) that we have experienced
 - Observed changes in radiative, land surface, and ocean surface conditions
- Of the counterfactual “world that might have been” (Nat-Hist)
 - Anthropogenic forcings set to year 1850 values
 - Ocean and sea ice adjusted according to warming attributable to emissions
 - Explore different estimates of ocean cooling



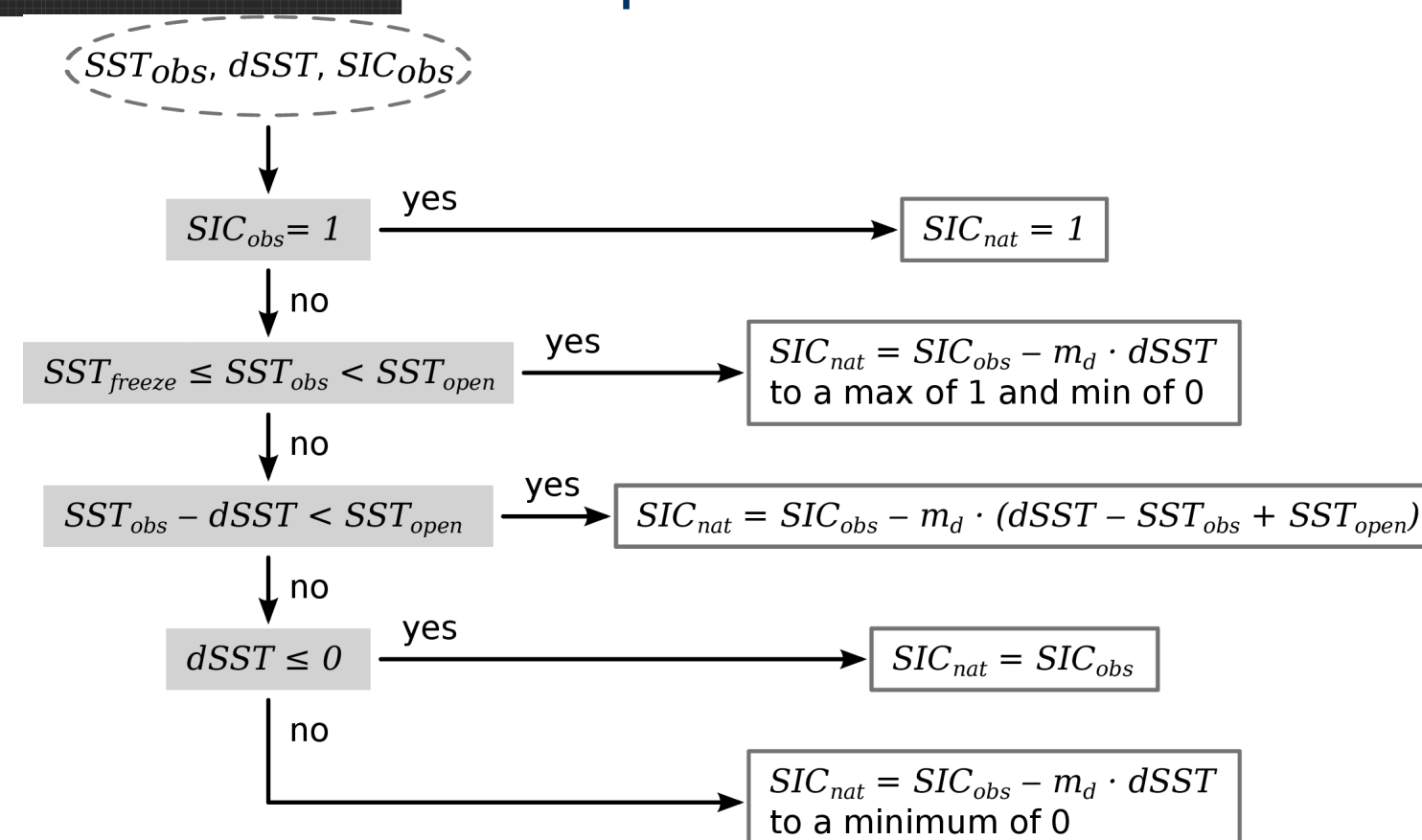
Estimation of counterfactual ocean conditions



Benchmark “Nat-Hist/CMIP5-est1” natural sea surface temperature

- Estimate from CMIP5 “historical” and “historicalNat” multi-model ensemble
- Other estimates being explored too

“Nat-Hist/CMIP5-est1” natural sea ice concentration estimated by modification of “All-Hist” observed concentration

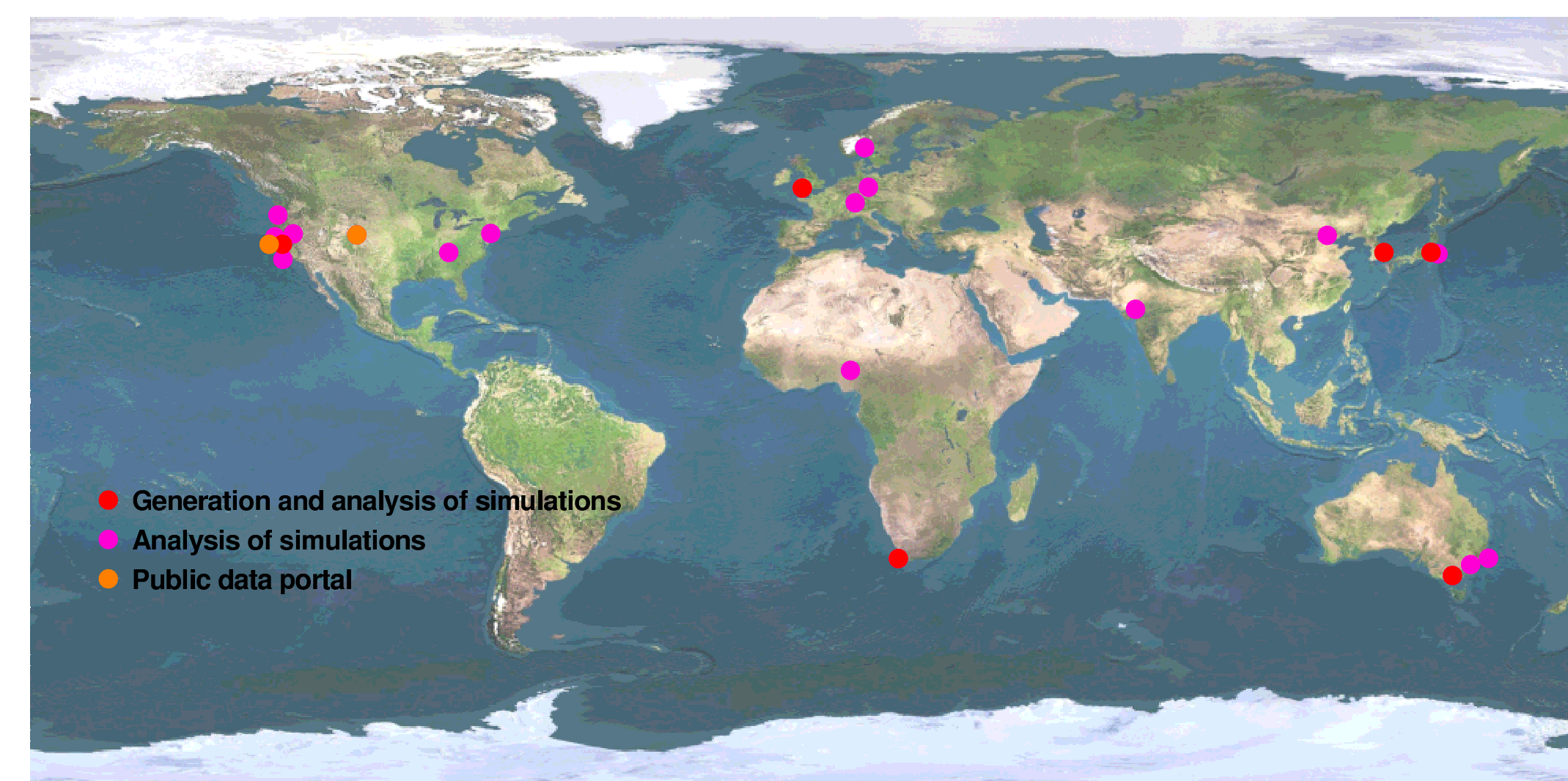


International collaboration

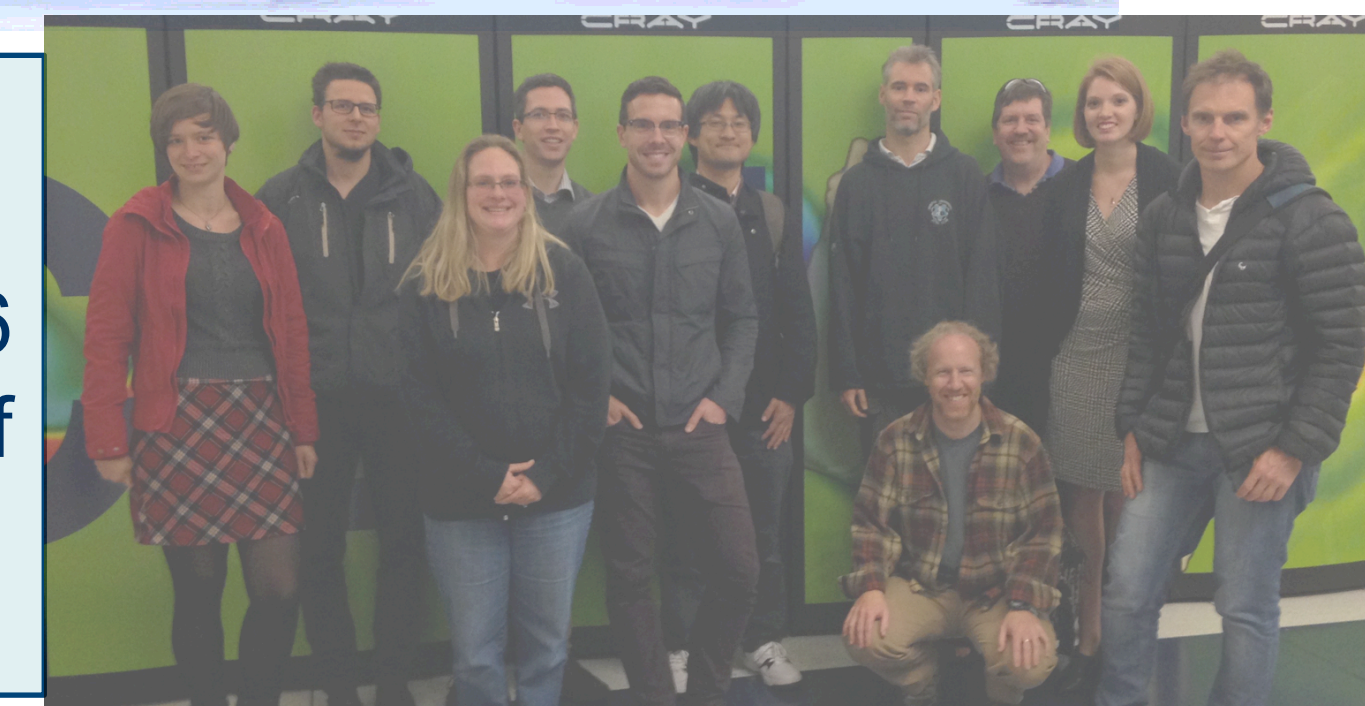
100TB of output published publicly, PB pending...
(8 global atmospheric models, 18,810 total simulation years, 18,779 1°×1° model equivalent)

- No registration required.
- Portal services by NERSC (National Energy Research Scientific Computing Center)
 - ~50TB on disk, rest on tape, accessible through single portal
 - <http://portal.nersc.gov/cascade/data/downloader.php>
- Additional online analysis services by NOAA-ESRL and CIRES
 - Selected monthly output at <http://www.esrl.noaa.gov/psd/repository/alias/facts>

Current contributors and users of C20C+ D&A data



- LBNL-hosted hackathon during 7-11 Dec 2015
 - Next hackathon 5-9 Dec 2016
- Preparation for a special issue of the journal *Weather and Climate Extremes*: open invitation



Independent tests of recent event attribution assessments

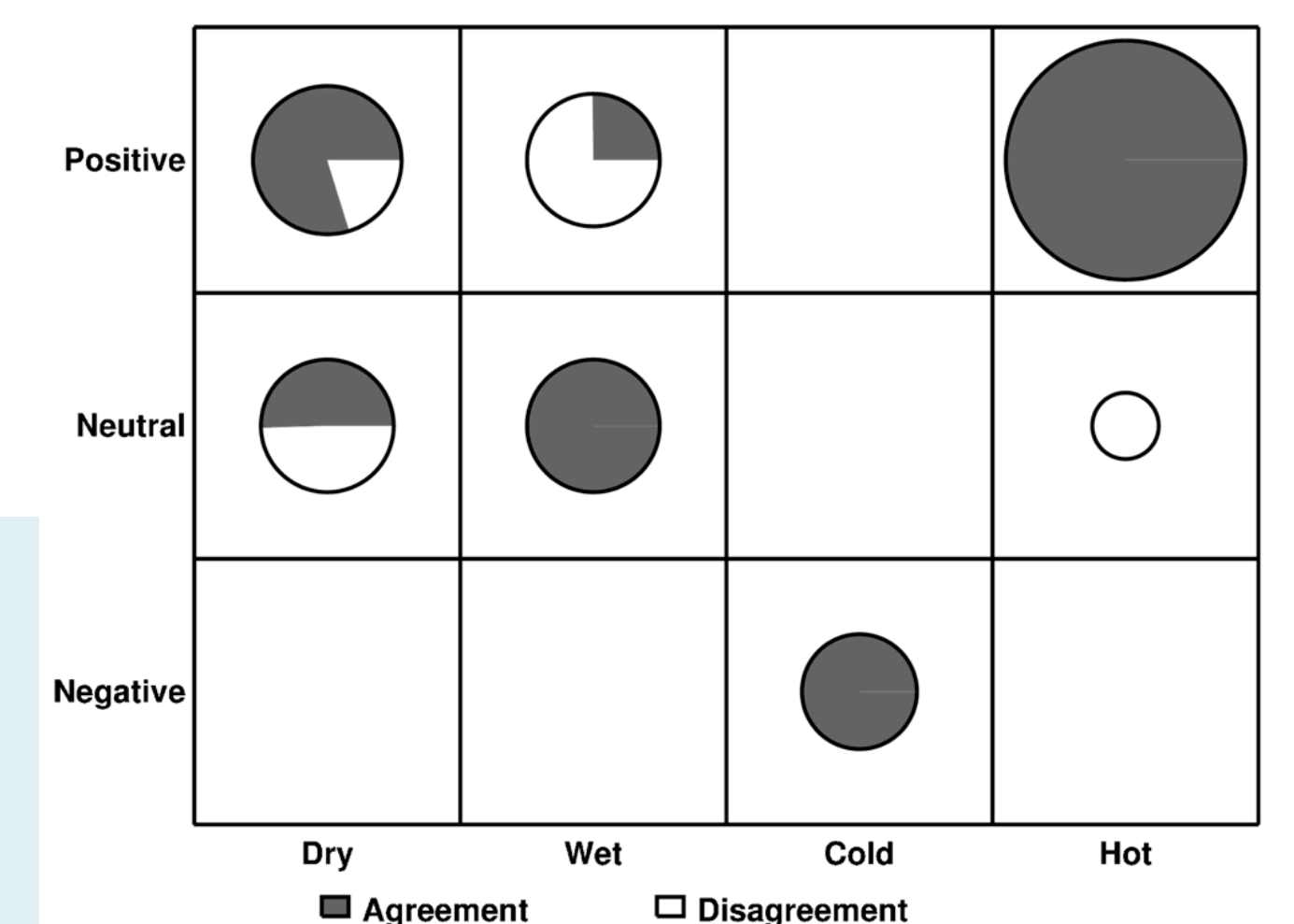
Led by Oliver Angélil (Lawrence Berkeley National Laboratory). In press in *J. Climate* (10.1175/JCLI-D-16-0077.1).

Since 2012, the annual “BAMS State of the Climate Report” has includes brief analyses of the role of emissions in extreme weather during the previous year. Each analysis uses a different concept of attribution, method, and set of data sources.

- Do conclusions hold with a standard concept/method/dataset? Issues satisfied by C20C+ D&A:
- Analysis requires large ensembles of multiple years.

Agreement between BAMS attribution supplement and “systematic” assessment.

Conclusions for temperature events confirmed, but conclusions sensitive for precipitation events.



The late onset of the 2015 wet season over Nigeria

Led by Kamoru Lawal (Nigerian Meteorological Agency). Submitted to the *Bull. Amer. Meteor. Soc.*

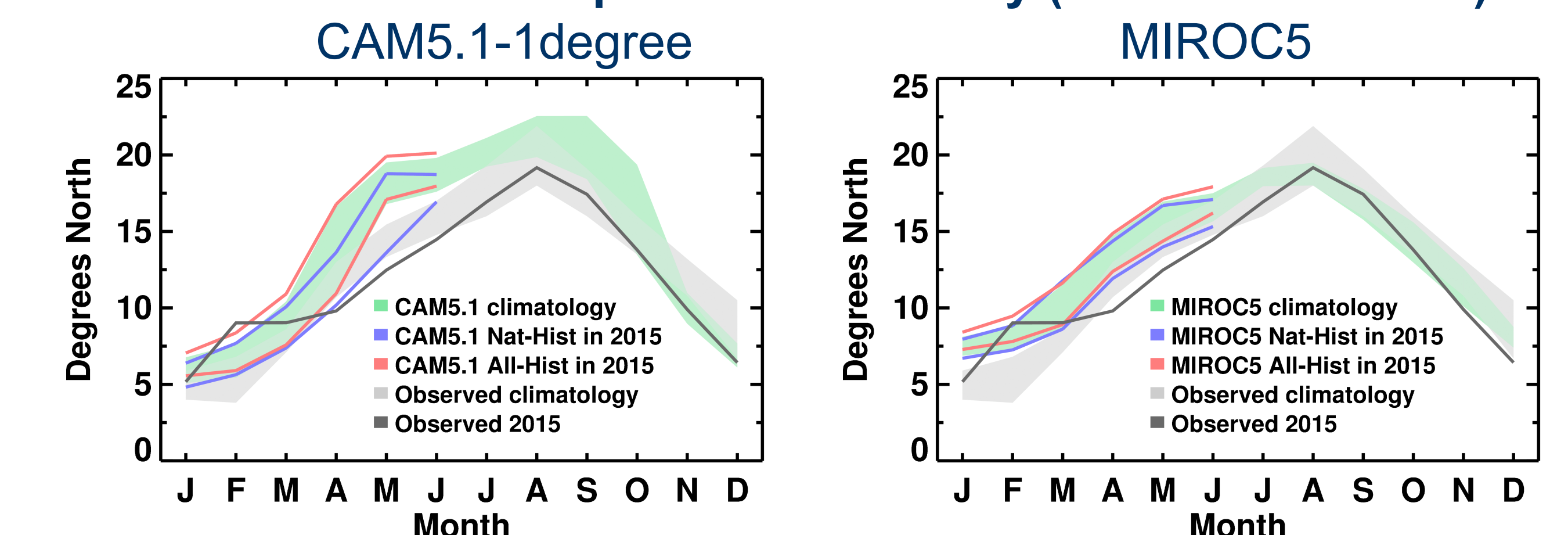
The onset (April-May) of the wet season over Nigeria was about one month late in 2015, an exceptional delay.

- Were anthropogenic emissions a factor?
- Was natural ocean variability a factor?

Issues satisfied by C20C+ D&A:

- Analysis requires large ensembles of single year.
- NMA lacks capacity for large modeling exercise.

Latitude of Inter-Tropical Discontinuity (measure of onset).



Emissions and ocean temperatures made this event less likely!

Acknowledgments

This work has been funded by:

- The U.S. Department of Energy, Office of Science, Office of Biological and Environmental Research's Regional and Global Climate Modeling Program;
- The Program for Risk Information on Climate Change, Ministry of Education, Culture, Sports, Science, and Technology of Japan;
- The Water Research Commission, South Africa;
- The E.U.'s Seventh Framework Programme;
- The Australian Research Council.